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Effect of different cultural practices on production of turmeric (*Curcuma longa* L.) in Punjab

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Abstract

Field experiments were conducted at Ludhiana (Punjab) to study the effect of different cultural practices on production of turmeric (*Curcuma longa* L.). Number of tillers, dry matter accumulation, number of rhizomes plant^{-1} and yield were significantly higher when mother rhizomes were used as planting material as compared to primary and secondary fingers. Quality parameters and nutrient uptake also increased with increase in planting material size. Number of tillers, dry matter accumulation, number of rhizomes plant^{-1} and yield decreased significantly with delay in planting from 25th April to 25th May. Quality parameters and nutrient uptake were also better with 25th April planting. Rhizomes plant^{-1}, yield, quality parameters and nutrient uptake were not affected by different harvesting dates. Mother rhizomes as planting material and 25th April planting resulted in maximum net return and benefit:cost ratio.

Keywords: cultural practices, mother rhizome, primary finger, secondary finger, yield

Introduction

Turmeric (*Curcuma longa* L.) is propagated vegetatively using both mother as well as finger rhizomes. The type of planting material used affects the vigour of the plant, yield as well as the cost of production of turmeric (Kumar 2005). The time of planting and maturity of turmeric also vary in different agro-climatic zones of India. The time of planting also influences the growth and development of turmeric (Min *et al*. 1996; Bandopadhyay et al. 2005). The optimum stage of harvesting plays an important role in obtaining the optimum yield and quality of turmeric (Kumar 2005). The present investigation was undertaken to study the effect of different cultural practices on production of turmeric in Punjab.

Materials and methods

Field experiments were conducted in 2007–08 and 2008–09 in well drained sandy loam soil under irrigated condition at Punjab Agricultural University, Ludhiana (30–54^{o} N latitude and 75–48^{o} E longitude, with an altitude of 247 m above MSL). The soil of the experimental field was low in available nitrogen (185.0 kg ha^{-1}) and organic carbon (0.21%), medium in available phosphorus (13.3 kg ha^{-1})

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and potassium (200.0 kg ha^{-1}) with pH 7.8. The experimental layout accommodated 27 treatment combinations, comprising three planting material (mother rhizome: 25–30 g, primary finger: 15–20 g and secondary finger: 5–10 g), three planting dates (25th April, 10th May and 25th May) and three harvesting dates (25th January, 15th February and 5th March). The experiment was laid out in randomized block design (factorial) with three replications. A common dose of 30 t ha^{-1} farm yard manure was applied before planting. Planting was done manually with hand hoe. Light irrigations were applied frequently till the crop sprouted and about 24 irrigations were applied during the crop season. Harvesting was done manually and the weight of fresh rhizomes per plot was recorded. The essential oil content (% w/v) was estimated by hydro-distillation using Clevenger's apparatus. The curcumin content (%) was calculated as per Thimmaiah (1999). N, P and K uptake by turmeric were estimated at harvest stage. The costs of cultivation, net returns and benefit:cost (B:C) ratio were calculated on the basis of fresh rhizome yield @ Rs. 10 kg^{-1}.

Results and discussion

The sprouting of rhizomes was maximum between 50 to 55 days after planting (DAP). The planting materials failed to influence crop emergence significantly (Table 1). The non-significant effect of different types of planting materials on emergence has also been reported by Kumar (2005). The planting materials had significant effect on the production of tillers $plant^{-1}$ at all the stages of crop growth. The number of tillers $plant^{-1}$ was significantly higher when mother rhizomes were used. Decrease in size of planting material significantly reduced tillers $plant^{-1}$ (Table 1). Similar results were reported by Deshmukh *et al*. (2005) and Kumar (2005). Dry matter $plant^{-1}$ increased with increase in age of the plants up to 200 (DAP) and decreased at harvest. The decrease in dry matter at harvest might be due to deterioration of leaves and tillers. The type of planting material had significant effect on dry matter accumulation at all the stages of crop growth and decreased significantly with decrease in size/weight of planting materials, from mother rhizome (25–30 g) to primary (15–20 g) and then from primary (15–20) to secondary (5–10 g) fingers at all stages of crop growth (Table 1). The higher dry matter accumulation when mother rhizome was used as planting material was mainly due to increased plant height and more number of leaves and tillers $plant^{-1}$ than primary as well as secondary fingers. Hossain *et al*. (2005) also reported that heavier rhizome (52 and 50 g) resulted in significantly more above ground biomass $plant^{-1}$ when compared with lighter rhizome. The type of planting material did not influence the senescence of leaves (Table 1). Kumar (2005) also reported that planting material had non-significant effect on leaf senescence. The planting dates significantly influenced emergence of turmeric at all the crop growth stages except at 60 DAP. Maximum emergence was observed with 25th April planting at all stages of crop growth and it decreased with delay in planting (Table 1). The planting dates also had significant effect on number of tiller $plant^{-1}$ at 140, 170, 200 DAP and at harvest. The number of tillers $plant^{-1}$ was maximum at 25th April planting and it decreased with delay in planting at all stages of crop growth. At harvest, the number of tillers $plant^{-1}$ with 25th April and 10th May planting were at par but it decreased significantly in 25th May planting (Table 1). Similar results have been reported by Bandopadhyay (2005) and Ishimine et al. (2004). The planting dates had significant effect on dry matter accumulation of turmeric. Early planting date (25th April) produced significantly more dry matter as compared to 10th May and 25th May planting at all stages of crop growth (Table 1). At harvest, dry matter accumulation decreased with delay in planting though the differences between 25th April and 10th May planting were non-significant. Higher dry matter accumulation with 25 April planting was mainly due to enhanced growth period which had favourable effect on growth parameters like plant height and leaves and tillers $plant^{-1}$. The planting dates also had significant effect on leaf senescence at 200 and 230 DAP. Minimum leaf senescence was observed with 25th April planting which was

Table 1. Effect of planting materials and planting dates on emergence count, number of tillers plant^{-1}, dry matter accumulation plant^{-1} and leaf senescence in turmeric

Treatment	Emergence count (%)	Tillers plant^{-1}				Dry matter accumulation plant^{-1} (g)						Leaf senescence (%)	
	60 DAP	140 DAP	170 DAP	200 DAP	At harvest	80 DAP	110 DAP	140 DAP	170 DAP	200 DAP	At harvest	200 DAP	230 DAP
Planting material													
Mother rhizome	96.32 (81.13)*	2.0	2.5	3.6	3.2	8.93	13.15	19.13	21.64	18.37	18.37	44.0	87.6 (78.1)
Primary finger	94.41 (79.10)	1.6	2.1	3.0	2.7	5.89	7.75	12.50	15.46	13.30	13.30	46.2	88.9 (79.3)
Secondary finger	92.45 (76.81)	1.2	1.7	2.4	1.7	2.84	4.92	8.16	9.10	9.55	9.21	47.6	92.1 (82.2)
CD (P=0.05)	NS	0.17	0.30	0.29	0.20	2.00	2.02	1.80	2.00	2.89	3.00	NS	NS
Planting dates													
25 April	95.47 (79.51)	1.8	2.5	3.5	2.7	8.20	11.67	16.20	19.14	20.31	16.80	35.1	80.9 (71.9)
10 May	94.38 (78.10)	1.6	2.2	2.8	2.6	6.10	8.10	12.80	14.82	15.33	14.33	48.8	87.7 (77.8)
25May	93.51 (80.21)	1.5	2.1	2.3	2.3	3.35	6.04	10.80	12.22	12.45	9.75	54.1	100.0 (89.2)
CD (P=0.05)	NS	0.17	0.3	0.29	0.20	2.00	2.02	1.80	2.00	2.89	3.00	3.10	4.12

*Figures in parentheses are arcsine transformed values; Values indicate pooled data of 2 years; DAP=Days after planting

significantly less than 10th May and 25th May planting while 10th May had significantly less senescence than 25th May planting at 200 and 230 DAP (Table 1).

The number and weight of mother rhizomes plant^{-1} decreased with decrease in size/weight of planting materials. Mother rhizomes produced maximum number and weight of rhizomes per plant (Table 2). This might be due to quick emergence of the crop, which remained photosynthetically active for longer period and resulted in more plant height with higher number of leaves and dry matter which ultimately led to higher number of rhizomes plant^{-1}. Similar results have been reported by Govind *et al*. (1993) and Kumar (2005). The number and weight of rhizomes per plant decreased significantly with delay in planting from 25 April to 25 May. Turmeric planted on 25 April produced maximum number and weight of rhizomes per plant (Table 2). This might be due to quick emergence of the crop, with higher number and weight of leaves, as well as more tillers which resulted in more number and weight of rhizomes plant^{-1}. Similar findings have been reported by Bandopadhyay (2005) and Min *et al*. (1996).

The effect of different planting materials on the fresh and dry rhizome yield of turmeric was significant. Mother rhizome produced significantly more fresh rhizome yield (18.9 ha^{-1}) than primary fingers (14.6 tha^{-1}) which was also significantly better than secondary fingers (9.4 ha^{-1}) (Table 2). Dry rhizome yield decreased significantly with decrease in size/ weight of planting material. Differences in performance of different sizes of rhizomes can be relied on source-sink relationship as the mother rhizome constitutes a stronger source and sink than the fingers. Similar results have been reported by Deshmukh *et al*. (2005) and Junior *et al*. (2005). The planting material had non-significant effect on dry recovery. The planting dates had significant effect on fresh and dry rhizome yield. Maximum fresh (17.1 tha^{-1}) and dry rhizomes yield (3.8 tha^{-1}) were produced at 25th April planting and each delay in planting decreased the yield significantly

Table 2. Effect of planting materials, planting and harvesting dates on number and weight of rhizomes plant^{-1}, yield and economics of turmeric (pooled data of 2 years)

Treatment	No. of rhizomes plant^{-1}	Weight of rhizomes plant^{-1}	Fresh rhizome yield (t ha^{-1})	Dry rhizome yield (t ha^{-1})	Dry re-covery (%)	Culti-vation cost (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Planting material								
Mother rhizome	17.3	121.0	18.9	4.2	22.4	33780	84429.5	2.3
Primary finger	12.7	101.4	14.6	2.9	20.2	31280	66727.3	2.1
Secondary finger	10.1	59.6	9.4	2.1	20.9	28780	47027.3	1.6
CD (P=0.05)	1.56	8.00	1.63	0.63	NS	1561	5211.00	0.15
Planting date								
25 April	16.9	105.3	17.1	3.8	22.1	31280	76520.6	2.4
10 May	13.2	94.2	14.4	3.1	21.6	31280	66298.4	2.0
25 May	10.2	83.0	11.8	2.3	19.6	31280	55365.1	1.7
CD (P=0.05)	1.56	8.00	1.63	0.63	NS	NS	5211.00	0.15
Harvesting date								
25 January	12.8	90.4	13.6	2.9	21.4	31280	63542.8	2.0
15 February	13.4	94.5	14.5	3.1	21.4	31280	66298.4	2.0
5 March	13.6	97.3	15.2	3.2	21.1	31280	68342.8	2.1
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Fresh rhizome @ 10 Rs kg^{-1}; Planting material: mother rhizome 14.8 q ha^{-1}, primary finger 12.3q ha^{-1}, secondary finger 9.8 q ha^{-1}; FYM @ 80 Rs t^{-1}

(Table 2). The maximum yield obtained at 25th April planting might be due to longer growth period of the plants which had resulted in better growth, development and yield attributing parameters. Higher turmeric yield due to early planting from 15 March to Ist week of May has been reported by Bandopadhyay (2005) and Ishimine *et al*. (2004). Dry recovery was not significantly affected by planting dates. The harvesting dates had non-significant effect on fresh and dry rhizome yield and dry recovery.

The oil and curcumin contents in processed turmeric decreased with decrease in size of planting material and also delay in planting dates though the differences were non-significant (Table 3). Kumar (2005) also reported that type of planting material had non-significant effect on oil and curcumin contents. Ishimine *et al*. (2004) reported maximum essential oil and curcumin content when the crop was planted on 15th April. The effect of planting material on oil and curcumin yield was significant during both the years. Mother rhizomes produced significantly more oil and curcumin yield than primary and secondary fingers. However, primary fingers were significantly better than secondary fingers for oil and curcumin yield (Table 3). The planting dates had significant effect on oil and curcumin yield during both the years. Maximum oil and curcumin yield was obtained with 25th April planting and delay in planting decreased the oil and curcumin yield significantly (Table 3). The harvesting dates had no significant effect on oil and curcumin yield (Table 3).

N, P and K uptake by leaves and rhizomes were higher with mother rhizomes (Table 3). Maximum N, P and K uptake was obtained with 25th April planting and delay in planting decreased the N, P and K uptake significantly. Different harvesting dates had no significant effect on N, P and K uptake (Table 3).

The cost of cultivation decreased with decrease in size of planting material. Maximum net return and benefit:cost (B:C) ratio were obtained with mother rhizomes which were significantly higher than primary and secondary fingers (Table 2). Delay in planting, resulted in decrease in net return and B:C ratio. Maximum net return and B:C ratio were obtained with 25th April planting which was

Table 3. Effect of planting materials, planting and harvesting dates on quality parameters and nutrient uptake by turmeric at harvest (pooled data of 2 years)

Treatment	Oil content (%)	Oil yield (kg ha^{-1})	Curcumin content (%)	Curcumin yield (kg ha^{-1})	Nutrient uptake (kg ha^{-1})					
					Leaf			Rhizome		
					N	P	K	N	P	K
Planting material										
Mother rhizome	6.84	269.0	2.32	90.5	48.8	7.2	77.1	60.6	9.6	102.6
Primary finger	6.75	185.5	2.23	61.5	34.3	3.9	56.8	41.5	5.0	72.3
Secondary finger	6.60	126.1	2.13	40.6	21.6	2.5	36.6	28.4	3.3	47.8
CD (P=0.05)	NS	29.8	NS	14.15	5.82	0.50	7.00	7.40	1.60	12.8
Planting date										
25 April	6.85	243.5	2.29	81.5	43.4	6.0	70.9	54.8	8.0	92.6
10 May	6.68	191.1	2.21	63.2	36.0	4.4	59.9	43.2	5.5	73.1
25 May	6.65	145.8	2.16	47.9	24.3	2.9	40.3	32.4	3.8	54.8
CD (P=0.05)	NS	29.8	NS	14.15	5.82	0.50	7.00	7.40	1.60	12.8
Harvesting date										
25 January	6.57	177.4	2.08	56.3	37.4	4.4	60.2	39.5	5.3	66.8
15 February	6.73	196.7	2.28	66.3	34.4	4.2	57.3	44.7	5.9	75.0
5 March	6.86	205.5	2.30	69.5	31.6	4.6	53.3	46.2	6.4	77.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	1.60	NS

significantly higher than 10th May and 25th May (Table 2) as planting dates. Different harvesting dates had no significant effect on net return and B:C ratio.

The study indicated that use of mother rhizome as planting material and planting on 25th April gave higher productivity and profitability of turmeric in Punjab.

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